

Claims

[c1] WHAT IS CLAIMED IS:

1. A method of forming a polycrystalline diamond element comprising a body with a working surface, wherein a first volume of the body remote from the working surface contains a catalyzing material and a second volume of the body adjacent to the working surface is substantially free of the catalyzing material to a depth from the working surface, by depleting the catalyzing material from the second volume of the body to a depth from the working surface such that a thermal gradient of the bonded diamonds causes a 950 degrees C temperature at the working surface to be less than 750 degrees C at the depth.

[c2] 2.The method of Claim 1, wherein the depleting process causes the thermal gradient to be greater than 1000 degrees C per mm.

[c3] 3.The method of Claim 2, wherein the thermal gradient is greater than 2000 degrees C per mm.

[c4] 4.The method of Claim 1, wherein the second volume of the body has a diamond density higher than elsewhere in

the body.

- [c5] 5.The method of Claim 1, wherein a majority of the catalyzing material remaining in the second volume of the body adheres to surfaces of diamond crystals.
- [c6] 6. The method of Claim 1 wherein the body is bonded to a substrate of less hard material.
- [c7] 7. The method of Claim 6 wherein the less hard material is cemented tungsten carbide.
- [c8] 8.The method of Claim 1 comprising a preform cutting element having a facing table and a cutting surface, wherein the working surface comprises a portion of the cutting surface.
- [c9] 9.The method of Claim 8, wherein the cutting element is mounted upon a cutting face of a fixed cutter rotary drill bit.
- [c10] 10.The method of Claim 8, wherein the cutting element is mounted upon a body of a rolling cutter drill bit.
- [c11] 11. The method of Claim 1, wherein the body comprises a plurality of partially bonded diamond crystals and an interstitial matrix, and wherein the part of the interstitial matrix located within the first volume contains the catalyzing material, and the part of the interstitial matrix

located within the second volume is substantially free of the catalyzing material.

- [c12] 12. The method of Claim 11, wherein the depleting process causes the thermal gradient to be greater than 1000 degrees C per mm.
- [c13] 13. The method of Claim 11, wherein the depleting process causes the thermal gradient to be greater than 2000 degrees C per mm.
- [c14] 14. The method of Claim 11, wherein the second volume of the body has a diamond density higher than elsewhere in the body.
- [c15] 15. The method of Claim 11, wherein a majority of diamond crystals located within the second volume of the body have a surface which is substantially free of catalyzing material.
- [c16] 16. The method of Claim 11, wherein a majority of the catalyzing material remaining in the second volume of the body adheres to surfaces of the diamond crystals.
- [c17] 17. The method of Claim 11, wherein the diamond crystals in the second volume remote from the first volume have less catalyzing material adhering to their surfaces than the diamond crystals in the second volume which

are adjacent to the first volume.

- [c18] 18. The method of Claim 11, wherein an amount of catalyzing material within the second volume of the body continuously decreases with distance from the first volume.
- [c19] 19. The method of Claim 11, wherein an amount of catalyzing material within the second volume of the body increases with increasing distance from the first volume.
- [c20] 20. The method of Claim 19, wherein the amount of catalyzing material within the second volume increases in steps.
- [c21] 21. The method of Claim 11 comprising a preform cutting element having a facing table and a cutting surface, wherein the working surface comprises a portion of the cutting surface.
- [c22] 22. The method of Claim 21, wherein the cutting element is mounted upon a cutting face of a fixed cutter rotary drill bit.
- [c23] 23. The method of Claim 21, wherein the cutting element is mounted upon a body of a rolling cutter drill bit.
- [c24] 24. The method of Claim 11, comprising a cutting element with a cutting surface adapted for use as a cutting

insert in a machining operation, wherein the working surface comprises a portion of the cutting surface.

[c25] 25. The method of Claim 11, comprising a drawing die, wherein the working surface comprises a portion of the drawing die contact surface.

[c26] 26. The method of Claim 11, comprising a heat sink.

[c27] 27. The method of Claim 11, comprising a device selected from the group consisting of a valve surface, indenter, tool mandrel, and wear element for a measuring device.

[c28] 28. The method of Claim 11 wherein the body is bonded to a substrate of less hard material.

[c29] 29. The method of Claim 28 wherein the less hard material is cemented tungsten carbide.